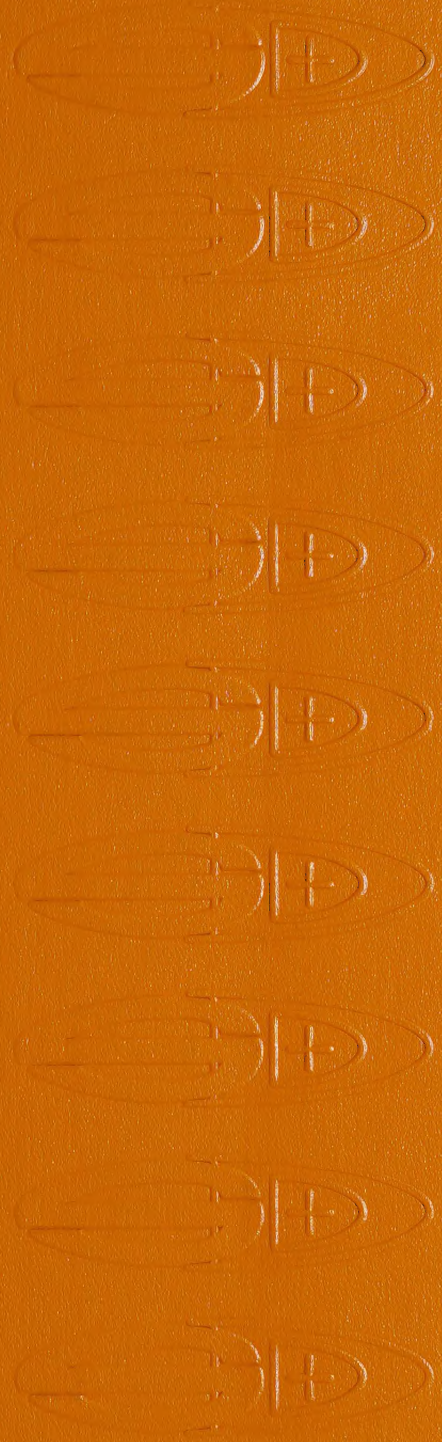

MODEL TL8-30V
TRIPLE OUTPUT POWER
SUPPLY

SERIAL NO.

SYSTRON DONNER

INSTRUCTION MANUAL

MODEL TL8-30V
TRIPLE OUTPUT POWER
SUPPLY

SERIAL NO.

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CONCORD INSTRUMENT DIVISION
10 Systron Drive • Concord, California 94518 • U.S.A.
Tel: (415) 676-5000 • TWX: 910-481-9479 • Cable: SYSTRONDONNER

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SECTION 1
DESCRIPTION

1.1 INTRODUCTION

The TL8-3 Triple Output Lab Series power supplies are flexible and dependable sources of DC power, which can be used to meet a variety of needs. These needs may range in scope from inspection and production testing, to laboratory bench testing and systems applications.

The wide range of outputs available makes these units well suited for use as basic laboratory power sources. The ability to provide power packaged in minimum space with high reliability meets the demands of most systems and laboratory requirements.

This instruction manual provides general characteristics and specifications, operating procedures, theory of operation, maintenance and troubleshooting, calibration, parts list and related schematics for the TL8-3 power supply.

1.2 DESCRIPTION

The TL8-3 power supply is a multiple output unit specifically designed for laboratory applications utilizing IC circuitry. Independent output voltages are provided to allow simultaneous power to be supplied to a typical IC (digital or analog) breadboard circuit and two additional independent power sources for typical auxiliary circuitry. Output voltage and currents may be independently monitored.

A variety of voltage and current outputs are available providing unexcelled operational versatility and flexibility. This output flexibility permits the user to have complete convenience in filling laboratory power requirements.

The Triple Lab Power Supply utilizes silicon semiconductors permitting operation at its maximum temperature rating without derating.

1.3 GENERAL FEATURES

Three independently adjustable outputs, automatic electronic current limiting, no turn on/turn off transients and three independent dual range meters are featured in the Model TL8-3 power supply. An Overvoltage Protection (OV) Option is also available in the TL8-3. Independent metering for each output allows simultaneous monitoring of voltages and current. A front panel lamp indicates an overload condition on any of the three outputs. Coarse and fine output controls for each output permit precise adjustability.

1.3.1 Constant Voltage Mode

A constant voltage is maintained across the output terminals at any preset value from zero to rated voltage output, provided that the load does not draw more than the rated output current.

1.3.2 Automatic Current Limiting

Short circuit protection is provided by the Automatic Current Limiting circuit which limits the maximum output current under all load conditions. The point at which automatic current limiting occurs is at approximately 110% of the maximum rated current output of the unit. In the event of a short circuit, the output voltage will drop to zero, and will return to its previous level only upon removal of the short circuit.

1.3.3 Automatic Overvoltage Protection (Optional Feature, "A" output only)

Automatic Overvoltage (OV) protection prevents the output voltage from exceeding the programmed voltage and can be internally adjusted through an access slot in the cover.

1.4 PRECAUTIONARY MEASURES

1.4.1 Wire Size

To assure proper regulation under all load consitions, and to prevent severe distortions of the AC line voltage, it is very important to take into concideration the physical size and current handling capabilities of the input power line. Serious losses in regulation and an increase in ripple may result from underrated or overloaded AC input lines. The maximum AC impedance from the breaker box to the power supply input should not exceed 0.75 ohms.

1.4.2 Voltage Regulator and Inverter Inputs

Do not use voltage regulators or inverters as a primary power source. The outputs of these devices are usually not sinusoidal in nature, and if used as the AC source for the power supply, may cause serious loss of regulation of the power supply output. Capacitive input filtering used for semiconductor power supplies requires charging to the peak of the rectified AC wave which nonsinusoidal AC sources may not provide.

1.4.3 System Considerations

In systems applications it is recommended that each power supply input power line be run separately to the AC distribution box, in order to minimize cross coupling and interaction between equipment. To keep the AC ripple in the output to a minimum, it is recommended that the AC input cables should not be run in close proximity to the output load cables.

The specifications cited herein for regulation and ripple can be readily attained on every power supply providing the proper method of measurement is employed. The major consideration is that the highly stable meter and oscilloscope, specified in the calibration procedures, must be connected to the sensing terminals and not the load terminals. The reason for this precaution is that the voltage drop between the load terminals and sensing terminals will yeild an inaccurate regulation ripple measurement.

1.5 SPECIFICATIONS

Table 1-1 is a complete list of standard specifications for the Model TL8-3.

TABLE 1-1 SPECIFICATIONS

ELECTRICAL SPECIFICATIONS:

Input:	105-125 VAC, 47-420 Hz; 105-115 VAC, 50 Hz.
Output:[1]	Triple floating; isolated from ground, 300 VDC max.
(A)	0 to +8 VDC, 3 ampere; rating reduces to 2 ampere at 0 VDC.
(B)	0 to +32 VDC, 1 ampere; rating reduces to 0.5 ampere at 0 VDC.
(C)	0 to -32 VDC at 1 ampere; rating reduces to 0.5 ampere at 0 VDC.

Model	Volts	Amps	Impedance*
TL8-3	0 to +8 VDC	0 to 3	0.003Ω
or	0 to +32 VDC	0 to 1	0.010Ω
TL8-3 OV	0 to -32 VDC	0 to 1	0.010Ω

*Nominal, DC-1 kHz

All outputs are referenced to a common return electrically isolated from chassis ground.

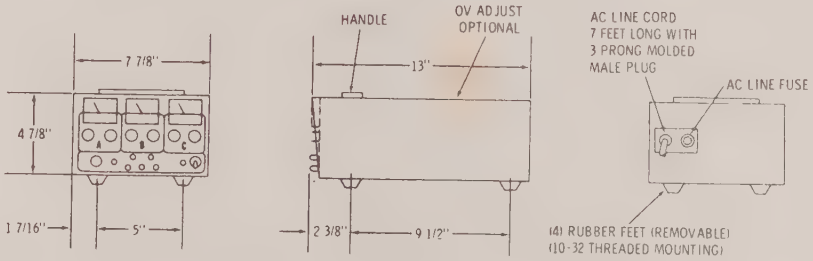
Regulation, Line:	0.02% or 2 mV^2, for 105-125 VAC line change, at any output within specifications.
Regulation, Load:	0.02% or 5 mV^2, no load to full load, at any output within specifications.
Ripple:	500 µV RMS; 3 mV p-p. (10 MHz) (20 mV p-p @420 Hz input).
Stability:	0.1% or 10 mV^2, for 8 hours after warm-up. Measured at constant line voltage, load and ambient temperature.
Temperature Coefficient:	0.02% +400 µV/°C.
Temperature Range:	0°C to +40°C.
Recovery Time:	50 µs to within 0.05% or 15 mV^2 or output voltage, for 80% step change in rated load. (.2 load to full load).
Short Circuit Protection:	Automatic Electronic Current Limiting.
AC Power Input Protection:	Fuse.
Voltage Adjustment Range:	Continuously adjustable vernier controls.

[1]At maximum line voltage condition, the total output current should not exceed 80% of total allowable current.
[2]Whichever is greater

TABLE 1-1 SPECIFICATIONS (Cont'd)

GENERAL AND PHYSICAL SPECIFICATIONS

Design Principle:	Precision Series Pass Regulation.
Operation Mode:	Constant voltage with automatic current liminting.
Controls:	
Voltage:	Coarse and Fine; 0 to rated output; front panel. Resolution 1 mV on fine control.
Input Power:	Front panel switch and indicator, AC ON.
Metering:	(3) Combination Volt/Ammeters with front panel selector switch.
Front Panel Terminals:	Positive output A, Positive output B, Negative output C, common return, chassis ground.
Overvoltage Protection:	Internal adjustable overvoltage protection is available, as a factory option on output (0 to +8 VDC).
Size:	7-78"W x 4-7/8"H x 12-9/16"D.
Weight:	16 lbs.



SECTION 2

OPERATION

2.1 ELECTRICAL CONNECTIONS

Input, Power

A heavy duty 3 wire line cord and molded plug with grounding prong provides a path for input power to the unit.

The power handling ability of the AC power lines feeding AC power to the line cord must be considered, as serious losses in regulation and substantial increases in ripple can occur as a result of insufficient power handling capacity of these lines. The AC impedance from the breaker box to the power supply input connector should not exceed 0.75 ohms. All AC power line connections must be securely tightened, and any movable electric contact surface (such as the wiper arm of a variable transformer) should be kept clear of impedance producing oxide coatings.

Care should be exercised in selecting the proper wire size for the AC input lines. The figures listed in Table 2-1 will serve as a guide in making this selection.

TABLE 2-1 - AC INPUT WIRE SIZE

Length of Run (Single Lead)	Wire Size (AWG Standards)
10 feet or less	12
10 feet to 20 feet	10
20 feet to 50 feet	8
50 feet to 100 feet	6

Output, Front Panel

Five binding post terminals mounted on the front panel provide output and ground connections.

2.2 CONTROLS

Front Panel

FRONT PANEL CONTROLS

Name	Function
AC POWER	Toggle switch, controls input power.
VOLTAGE ADJUST (Coarse)	Potentiometer, adjusts voltage output.
VOLTAGE ADJUST (Fine)	Potentiometer, adjusts voltage output.
METER SELECT (V, I) (2 pos.)	Rotary switch, controls function of output meters.

Internal

All internal control settings have been factory preset, and require no additional adjusting. However, if it should become necessary to adjust any of the internal controls due to circuit changes caused by component aging or replacement, refer to the calibration section of this instruction manual.

2.3 OPERATION

Control Settings

Set all coarse and fine output controls fully CCW and set the meter select switch to V.

Grounding

Either side of either output may be grounded or the outputs may be used in a floating condition.

Power On

Connect the power supply to a nominal AC power source. Set power switch S1 to AC-ON, and observe that pilot lamp DS1 glows.

Warm-Up

No warm-up time is necessary to place the unit into operation. However, a 30 minute warm-up period is recommended to reach rated stability.

SECTION 3

THEORY OF OPERATION

3.1 GENERAL

The purpose of the TL8-3 Triple Output Lab Series power supplies is to transform and rectify the AC input into a well regulated, stable and adjustable DC output. The following paragraphs describe the major circuits. As each circuit is described, reference should be made to the schematic diagram in the rear of this manual.

Primary Input

Input power is obtained through transformer T101 full wave rectifier diode sets (CR1, CR10), (CR2, CR11), (CR19, CR20) and filter capacitors C3, C10 and C17.

When AC power switch S1 is set to AC-ON, AC pilot lamp DS101 glows, and AC power is applied to T101. Regulated DC output power is immediately available.

Reference Supplies

The C3 voltage appears across the +12V and (+10V, +6.2V) reference supplies. These reference voltages are, in turn, developed across CR25, CR5 and CR6, respectively.

The C10 voltage appears across the -12V and (-10V, -6.2V) reference supplies. These reference voltages are, in turn, developed across CR26, CR14 and CR15, respectively.

Series Regulator

The rectified and filtered voltages from the three input rectifier sections are directed through each of the respective series pass transistors. The conduction of each of these transistors is controlled by independent circuitry which causes them to act as variable resistors. Their overall resistance varies in accordance with the need of the power supply to increase or decrease the output voltage.

Each pass transistor is controlled by a driver transistor which is, in turn, controlled by the corresponding voltage (error) amplifier.

Voltage (error) Amplifier

The theory of operation for all three voltage amplifiers is identical. A sample of the output voltage is compared with a stable reference (see Reference Supplies) at the base of the input stage of the amplifier. An unbalance caused by a voltage change at either the output terminals or across the output control pots will appear as a voltage change at the collector of the first stage. For example, an increase in output causes the first stage to turn off, turning on the

second transistor, turning off the third transistor and turning off the driver transistor. This causes the pass to be turned off and the output voltage to decrease.

Current Limit Circuit

In the case of all three current limit circuits, a voltage drop is sensed across a small resistance in series with each output. As current increases, this voltage drop increases, eventually turning on a transistor in its current limit circuit which turns off the first stage of the voltage amplifier for this output. This has the overall effect of independently shutting down this output.

3.2 OPTIONAL FEATURES

Overvoltage (OV) Protection

If the output voltage should use above the threshold set by the OV pot, the OV sensing transistor will turnon, turning on the SCR driver. This applies a signal to the gate of the SCR causing it to "fire" and place a "crowbar" across the output. This short circuits the output and activates the current limit circuit which turns off the pass transistor.

SECTION 4

MAINTENANCE

- W A R N I N G -

High Voltages Are Present

Use Caution

4.1 GENERAL

This power supply is a precision instrument. It is strongly recommended that only experienced troubleshooting personnel perform troubleshooting operations or attempt to repair the unit. If the power supply appears to be malfunctioning at all, the following procedure is recommended for isolating possible defects.

4.2 LOADS AND INTERCONNECTIONS

1. Disconnect all interconnections and loads to which the unit is normally connected.

2. Connect a separate resistive dummy load across each output terminal. This load should be of sufficient value to allow the unit to operate at its maximum rated current and voltage output.

3. Apply nominal AC input power to the unit and check for normal operation. Satisfactory operation at this time would indicate that any malfunction previously encountered, is external in nature. All interconnections and loads normally used in conjunction with this power supply should then be carefully checked for electrical defects.

4.3 TROUBLESHOOTING

1. Set VOLTAGE ADJUST and VOLTAGE VERNIER controls fully CW. Using a 20,000 ohms per volt voltmeter or oscilloscope, check the voltages across the various circuit components listed in the TROUBLESHOOTING GUIDE, located immediately before the schematic diagram at the rear of this instruction manual. The sample voltages listed in this guide apply only if the unit is operating at its nominal AC input, and has no load on any output unless otherwise specified. Any reading which is grossly incorrect indicates that the stage being tested or the one immediately preceding it, is defective. The Schematic Diagram and appropriate sections of the Theory of Operation will prove

helpful in any troubleshooting work. Proper polarity to be observed when testing can be easily obtained from the Schematic Diagram.

2. If voltage checks show no noticeable deviations from the prescribed values, disconnect AC power and proceed with point-to-point resistance checks across pots, switches, diodes, resistors, transistors, in that order.

3. When the trouble is of an intermittent nature, such as poor regulation, ripple, etc., the use of an oscilloscope to determine dynamic changes will be necessary.

SECTION 5

CALIBRATION

5.1 GENERAL

The following adjustments should be made when necessary to assure optimum operating characteristics and maximum efficiency of the Trygon power supply.

5.2 TEST EQUIPMENT REQUIRED (or equivalent)

(A) Oscilloscope, Tektronix Type 561
(B) Differential Amplifier Plug In, Tektronix Type 63
(C) Time Base Plug In, Tektronix Type 67
(D) Differential VTVM, Fluke Model 825A
(E) DC Ammeter, Weston Model 901

5.3 CALIBRATION PROCEDURE

(A) Maximum Voltage - set front panel "V ADJ" fully clockwise, and "Fine" fully counter-clockwise for all three outputs. Adjust maximum voltage control R92 (0 to +32V), R93 (0 to -32V), and R94 (0 to +8V) to obtain the maximum rated output voltage for each output.

(B) (0 to +8V) Maximum Current - set output voltage equal to 8.00 VAC ± 10 mv. Monitor Vout with a scope (10mv/cm scale). Rotate the current adjust pot (R59) fully clockwise. With an external DC current meter and a variable load adjust the output current to 3.3 Amps. ±100ma. Slowly rotate R59 in the counter-clockwise direction until an affect is seen on the output voltage. Check the setting by adjusting the variable for max. current. The maximum current the unit should be capable of is 3.3 Amps.

(C) Meter Circuit - Place the meter select switch in the volts position. Adjust each output to its maximum voltage ±20mv. (Differential VTVM, Fluke Model 825A is recommended). Calibrate each meter by adjusting the meter face screw for the last division of the meter scale.

Place the meter select switch in the Amps position, then load down one output at a time. Monitor the output current carefully with an accurate DC current meter. For the 0 to +32V output, adjust R16 so both the "A" meter and the reference meter indicate the same current. For the 0 to -32V output, calibrate the "B" meter by adjusting R50. Finally, calibrate the "C" meter with R54.

TROUBLESHOOTING GUIDE

0 to +32V Output

Vin≈115VAC
No load on output unless otherwise specified

Symptom	Possible Problem Area	
Zero output voltage	AC Input Section	If the AC power lamp (DS101) is off, one or more of the components listed has probably failed. F101 open circuit; S101 open circuit; S102 open circuit.
Zero or small negative output voltage	Rectifier Section or -6.2V and -10V Reference Section	Measure the voltages across the following components. Check the levels measured with those indicated below. C3≈26V; CR14≈10V; CR15≈6.2V
	Series Pass and Driver Section	Measure the voltage drop across the base to emitter junction of Q101 and Q3 (across R9 and R6). Both transistor junctions should be forward biased.
	Voltage Amplifier Circuit	The base to emitter voltages of Q20, Q5 and Q6 should be about 0.6 volts DC, in the forward direction for that transistor.
Zero or small positive output voltage	Current Limit Circuit	If the voltage across R14 is approximately zero, then Q4 should be cut-off and CR7 reversed biased. If the voltage across R14 is significant, then there is current flowing in the supply. The output terminals are probably shorted to common.
Large and Unregulated Output Voltage	Series Pass and Driver Section or Voltage Amplifier Circuit	Check Q101 for collector emitter short " Q3 " " " " " Q20 " " " " " Q6 " " " " " Q5 " " " open
Output does not current limit	Voltage Amp. Ckt. or Current Limit Ckt. or -12V Reference Section	Probably Q4 has failed open and/or CR7 has failed open. Measure the voltage across CR26, the level is approximately 12 volts.

Symptom	Possible Problem Area	
Overload lamp does not turn on when current limiting	Overload Lamp Logic Circuit	Check for failure of DS102 overload lamp. With the supply in current limit operation, the base to emitter voltage of Q21 and Q1 should be about 0.6 volts in the forward direction.
Overload lamp always on	Overload Lamp Logic Circuit	Check Q21 for collector emitter short " Q1 " " " " (Insure that no other output is in current limit). Check Q24 for collector emitter short " Q23 " " " "

TROUBLESHOOTING GUIDE

0 to -32V Output

Symptom	Possible Problem Area	
Zero or small positive output voltage	Rectifier Section or -6.2V and -10V Reference Section	Measure the voltage across the following components. Check the levels measured with those indicated below. C10≈26V; CR5≈10V; CR6≈6.2V
	Series Pass and Driver Section	Measure the voltage drop across the base to emitter junction of Q102 and Q8 (across R32 and R33). Both transistor junctions should be forward biased.
	Voltage Amplifier Circuit	The base to emitter voltages of Q9, Q11 and Q12 should be about 0.6 volts DC, in the forward direction for that transistor.
Zero or small negative output voltage	Voltage Amplifier Circuit or Current Limit Circuit	If the voltage across R47 is approximately zero, then Q10 should be cut-off and CR16 reversed biased.
	Current Limit Circuit	If the voltage across R47 is significant, then there is current flowing in the supply. The output terminals are probably shorted to common.
Large and unregulated output voltage	Series Pass and Driver Section or Voltage Amplifier Circuit	Check Q102 for collector emitter short " Q8 " " " " " Q9 " " " " " Q12 " " " " " Q11 " " " open
Output does not current limit	Voltage Amplifier Circuit or Current Limit Circuit or +12V Reference Section	Measure the voltage across CR25, this is approximately 12 volts. Possibly Q10 has failed open and/or CR16 has failed open.
Overload lamp does not turn on when current limiting	Overload lamp Logic Circuit	Check for failure of DS102 overload lamp. With the supply in current limit operation, the base to emitter voltage of Q21 and Q24 should be about 0.6 volts in the forward direction.

TROUBLESHOOTING GUIDE

0 to +8V Output

Symptom	Possible Problem Area	
Zero or small negative output voltage	Rectifier Section or -6.2V and -10V Reference Section	Measure the voltage across the following components. Check the levels measured with those indicated below (at no load). C17≈17.5V, CR14≈10V, CR15≈6.2V.
	Series Pass and Driver Section	Measure the voltage drop across the base to emitter junction of Q103 and Q13 (across R57 and R56). Both transistor junctions should be forward biased.
	Voltage Amplifier Circuit	The base to emitter voltage of Q15, Q16 and Q17 should be about 0.6 volts DC, in the forward direction for that transistor.
Zero or small positive output voltage	Current Limit Circuit	If the voltage across R65 and R98 is approximately zero, then Q14 and Q23 should be cut-off. The base to emitter junction of Q23 should be reversed biased.
	Current Limit Circuit or Overvoltage Circuit	If the voltage across R65 and R98 is significant, then there is current flowing in the supply. The output terminals are probably shorted together, possibly by the overvoltage circuit.
Large and unregulated output voltage	Overvoltage Circuit	Set R74 fully CW. The base to emitter voltages of Q18 and Q19 should be approximately 0.6V forward biased. Q19 collector should be equal to the observed output.
	AND Series Pass and Driver Section or Voltage Amplifier Circuit	Check Q103 for collector emitter short " Q13 " " " " " Q15 " " " " " Q17 " " " " " Q16 " " " open

Symptom	Possible Problem Area	
Overvoltage triggers, even though output is normal and R74 is set fully CCW	Overvoltage Circuit or -12V Reference Section	Check Q18 for collector emitter short " Q19 " " " " Measure the voltage across CR26; the level should be 12 volts.
Output does not current limit	Current Limit Ckt. or +12V Reference Section or -12V Reference Section	Q14 failed open or CR23 failed open. Measure the voltage across the following components. Check the levels measured with those indicated below. CR25≈12V; CR26≈12V
Overload lamp does not light during current limiting	Overload lamp logic circuit	Check for failure of DS102 (overload lamp). With the supply in current limit operation, the base to emitter voltage of Q21 and Q1 should be about 0.6V forward biased.

REFERENCE	COMPONENT	MFR	MFR PART NUMBER	STOCK #
C 1	CAP .05 MF 200V	33498	LT GP 503M	80 01 68
C 2	CAP .05 MF 200V	33498	LT GP 503M	80 01 68
C 3	CAP 1600MF 60V	00835	PR IN T	81 99 53
C 4	CAP .01MF 600V	33498	AC OM GP103P	80 00 90
C 5	CAP .022MF 500V	*		80 01 29
C 6	CAP 15MF 35U		T3 62 C1 56 MO 35 AS	82 10 27
C 7	CAP 91MF 40V	00835	557	81 01 17
C 8	CAP .05 MF 200V	33498	LT GP 503M	80 01 68
C 9	CAP .05 MF 200V	33498	LT GP 503M	80 01 68
C 10	CAP 1600MF 60V	00835	PR IN T	81 99 53
C 11	CAP .05 MF 200V	33498	LT GP 503M	80 01 68
C 12	CAP 296MF 15V	00835	556	81 01 82
C 13	CAP 15MF 35U		T3 62 C1 56 MO 35 AS	82 10 27
C 14	CAP 91MF 40V	00835	557	81 01 17
C 15	CAP .05 MF 200V	33498	LT GP 503M	80 01 68
C 16	CAP .05 MF 200V	33498	LT GP 503M	80 01 68
C 17	CAP 5500MF 18 23V	00835	OR WG	81 99 85
C 18	CAP .01MF 600V	33498	AC OM GP103P	80 00 90
C 19	CAP .022MF 500V	*		80 01 29
C 20	CAP 5.6 MF 20V		T3 60 8	82 10 18
C 21	CAP 50PF 600V	33498	GP 500K	80 00 03
C 22	CAP .022MF 500V	*		80 01 29
C 23	CAP 0047MF 600V	33498	GP 472M	80 00 50
C 26	CAP .0033MF 600V	33498	GP 332K	80 00 25

REFERENCE	COMPONENT	MFR	MFR PART NUMBER	STOCK #
C 27	CAP 0047MF 600V	33498	CP472M	80 00 50
C 28	CAP 100PF 600V	*		80 00 07
CR 1	DIODE IN4384	14936	G100G110	72 03 84
CR 2	DIODE IN4384	14936	G100G110	72 03 84
CR 3	DIODE 1N752A	*	1N752A	72 01 85
CR 4	DIODE TR4148	21845	1N4148	72 04 40
CR 5	DIODE 1N758A	*		72 04 59
CR 6	DIODE IN 823	04713	1N823	72 04 61
CR 7	DIODE TR4148	21845	1N4148	72 04 40
CR 8	DIODE TR4148	21845	1N4148	72 04 40
CR 9	DIODE IN 4384	14936	G100G110	72 03 84
CR 10	DIODE IN4384	14936	G100G110	72 03 84
CR 11	DIODE IN4384	14936	G100G110	72 03 84
CR 12	DIODE TR4148	21845	1N4148	72 04 40
CR 13	DIODE 1N758A	*		72 04 59
CR 14	DIODE 1N758A	*		72 04 59
CR 15	DIODE IN 823	04713	1N823	72 04 61
CR 16	DIODE TR4148	21845	1N4148	72 04 40
CR 17	DIODE TR4148	21845	1N4148	72 04 40
CR 18	DIODE IN 4384	14936	G100G110	72 03 84
CR 19	DIODE MR 1031A	04713	MR1031A	72 04 54
CR 20	DIODE MR 1031A	04713	MR1031A	72 04 54
CR 21	DIODE TR4148	21845	1N4148	72 04 40
CR 23	DIODE TR4148	21845	1N4148	72 04 40

REFERENCE	COMPONENT	MFR	MFR PART NUMBER	STOCK #
CR 24	DIODE MR 1030A	04713	MR 1030A	720453
CR 25	DIODE IN 759A	81483	1N759A	720173
CR 26	DIODE IN 759A	81483	1N759A	720173
CR 28	DIODE 1N758A	*		720459
CR 29	DIODE TR4148	21845	1N4148	720440
CR 30	DIODE TR4148	21845	1N4148	720440
CR 31	DIODE TR4148	21845	1N4148	720440
F 3	FUSE 4A MDV	71400	MDV4A	871017
F 101	FUSE 2.5 AMP SLO BLO	71400	MDL	870175
J 1	CONNECTOR	02660	225-2221-103	839170
M 1	METER 32V-GREEN	33005	MS1T	753135
M 2	METER 32V YELLOW	33005	MS1T	753140
M 3	METER 8V-RED	33005	MS1T	753130
Q 1	TRANSISTOR	04713	2N2905	705067
Q 1	TRANSISTOR	04713	2N2905	705067
Q 2	TRANSISTOR	04713	2N2905	705067
Q 3	TRANSISTOR	04713	2N2905	705067
Q 4	TRANSISTOR	04713	2N2905	705067
Q 5	TRANSISTOR	07263	2N3638A	700002
Q 6	TRANSISTOR	07263	2N3638A	700002
Q 7	TRANSISTOR	05828	2N2219A	705068
Q 8	TRANSISTOR	05828	2N2219A	705068
Q 9	TRANSISTOR	04713	2N2905	705067
Q 10	TRANSISTOR	05828	2N2219A	705068

REFERENCE	COMPONENT	MFR	MFR PART NUMBER	STOCK #
Q 11	TRANSISTOR	30045	2N3566	7001 82
Q 12	TRANSISTOR	30045	2N3566	7001 82
Q 15	TRANSISTOR	30045	2N3566	7001 82
Q 16	TRANSISTOR	07263	2N3638A	7000 02
Q 17	TRANSISTOR	07263	2N3638A	7000 02
Q 20	TRANS 2N3440-SPEC	30045	DRWG	7002 05
Q 21	TRANS 2N3440-SPEC	30045	DRWG	7002 05
Q 22	TRANSISTOR	05828	2N2219A	7005 68
Q 24	TRANSISTOR	07263	2N3638A	7000 02
Q 101	TRANSISTOR	21845	SPEC CONT DWG	7005 71
Q 102	TRANSISTOR	21845	SPEC CONT DWG	7005 71
Q 103	TRANSISTOR	21845	SPEC CONT DWG	7005 71
Q 300	TRANSISTOR	04713	2N2905	7005 67
Q 301	TRANSISTOR	04713	2N2905	7005 67
Q 402	TRANSISTOR	04713	2N2905	7005 67
R 1	RCOMP 15K 5W 10	01121	RCR20	6103 00
R 2	RCOMP1 2K 5W 10	01121	RC 20	6101 90
R 3	RLTC 2.5K 3W 3	07088	1300S	6304 50
R 4	RMF 200 5W 1	12126	M1/2TI	6200 70
R 5	RMF 274R 5W 1	12126	M1/2T1	6200 95
R 6	RCOMP 330 .5W 10%	01121	RC 20	6101 20
R 7	RCOMP1 2K 5W 10	01121	RC 20	6101 90
R 8	RCOMP 27K .5W 10%	01121	RC 20	6103 20
R 9	RCOMP 68 .5W 10	01121	RC 20	6100 40

REFERENCE	COMPONENT	MFR	MFR PART NUMBER	STOCK #
R 10	RMF 15K .5W 1	12126	M1/2T1	620627
R 11	RMF 523 .5W 1	12126	M1/2T1	620193
R 12	RCOMP 220K .5W 10	01121	RCR20	610500
R 13	RWW5K 5W 5	12697	VC5E	640551
R 14	RLTC 2 5W 3	07088	KM30C	630065
R 15	RMF 2.7K .5W 1	12126	M1/2T1	620472
R 16	POT 750 1.5W	11236	PRINT	600151
R 17	RCOMP 100K .5W 10	01121	RCR20	610350
R 18	RCOMP 6.8K .5W U/	01121	RCR20	610270
R 19	RCOMP 82K .5W 10	*	RC20	610347
R 20	RCOMP 3.3K .5W 10	01121	RC20	610230
R 21	POT 150 2W 10%	11236	PRINT	600063
R 22	RCOMP 10K .5W 10	01121	RC20	610290
R 23	RCOMP 330 .5W 10%	01121	RC20	610120
R 24	RCOMP 27K .5W 10%	01121	RC20	610320
R 25	RMF 750 5W 1	12126	M1/2TI	620250
R 26	RMF 31.9K .5W 1	12126	M1/2T1	620685
R 27	POT55 2W 10%	12697	PRINT	600299
R 28	RCOMP 22K 2W 5	*	RC20	610311
R 29	RMF 340 .5W 1%	12126	M1/2TI	620130
R 30	RMF 243R 5W 1	12126	M1/2T1	620076
R 31	RCOMP 1K 2W 10	*	1K 2W 10%	610182
R 32	RCOMP 68 .5W 10	01121	RC20	610040
R 33	RCOMP 330 .5W 10%	01121	RC20	610120

REFERENCE	COMPONENT	MFR	MFR PART NUMBER	STOCK #
R 34	RCOMP 1 2K 5W 10	01121	RC 20	61 01 90
R 35	RMF 15K .5W 1	12126	M1/2T1	62 06 27
R 36	RCOMP 39K .5W 10%	*		61 03 35
R 37	RMF 523 .5W 1	12126	M1/2T1	62 01 93
R 38	RCOMP 27K .5W 10%	01121	RC 20	61 03 20
R 39	RCOMP 22K .5W 10	*	RC 20	61 03 10
R 40	RCOMP 3.3K .5W 10	01121	RC 20	61 02 30
R 41	RCOMP 330 .5W 10%	01121	RC 20	61 01 20
R 42	RCOMP 15K 5W 10	01121	RCR20	61 03 00
R 43	RCOMP 10K .5W 10	01121	RC 20	61 02 90
R 44	RCOMP 27K .5W 10%	01121	RC 20	61 03 20
R 45	RMF 750 5W 1	12126	M1/2TI	62 02 50
R 46	POT 55 2W 10%	12697	PRINT	60 02 99
R 47	RLTC 2 SW 3	07088	KM 300	63 00 65
R 48	RWW 5K 5W 5	12697	VC 5F	64 05 51
R 49	RCOMP 2.7K .5W 10	*	RC 20	61 02 26
R 50	POT 750 1.5W	11236	PRINT	60 01 51
R 51	RMF 31.9K .5W 1	12126	M1/2T1	62 06 85
R 52	RWW 3K 5W 5		VAL5	64 05 46
R 53	RCOMP 820 .5W 10	01121	RC 20	61 01 70
R 54	POT 500 1.5W	11236	DRWG 099030-5	60 01 46
R 55	RMF 7.9K .5W 1	12126	M1/2T1	62 06 05
R 56	RCOMP 390 .5W 10	*	RC 20	61 01 30
R 57	RCOMP 68 .5W 10	01121	RC 20	61 00 40

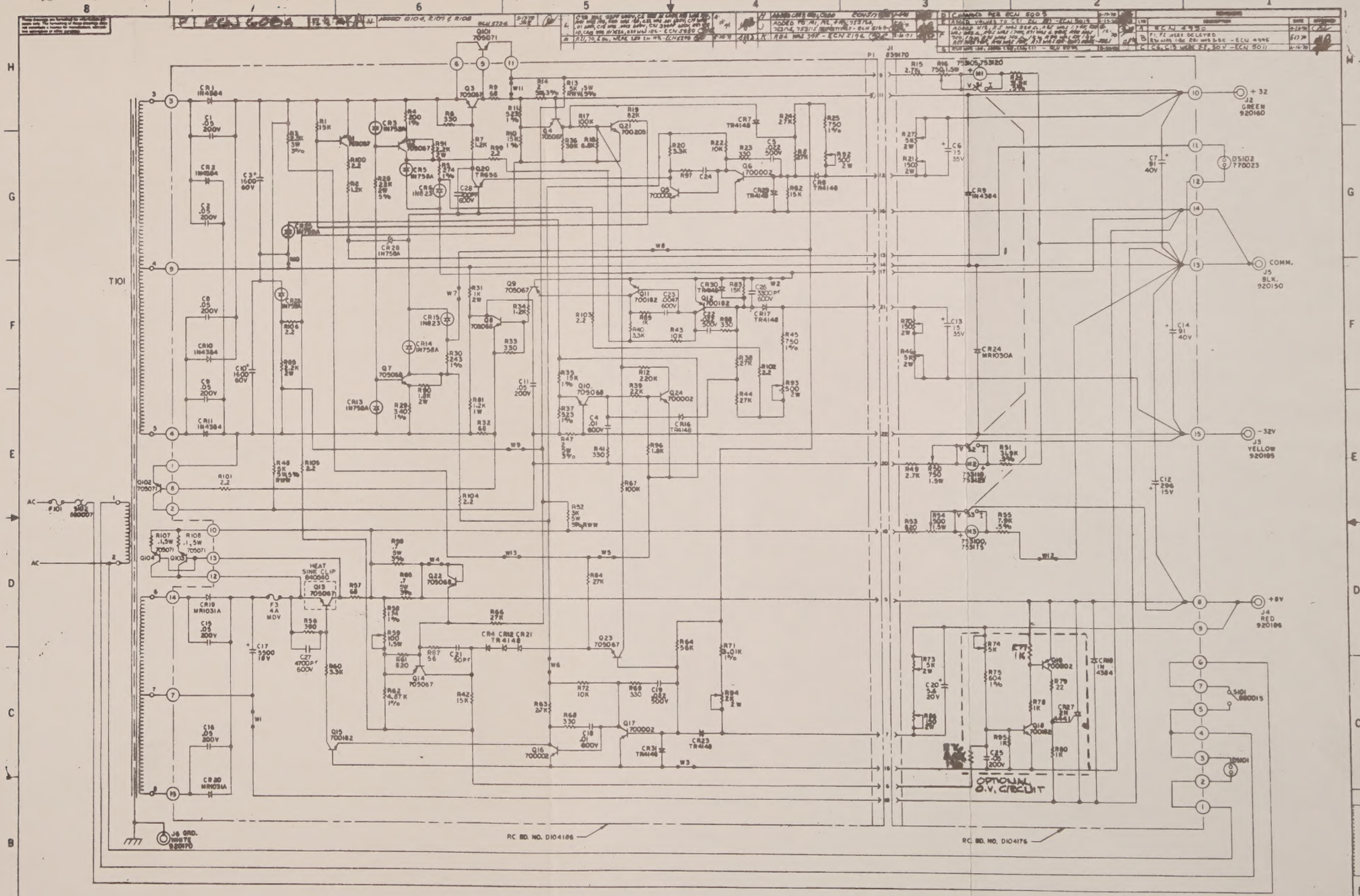
REFERENCE	COMPONENT	MFR	MFR PART NUMBER	STOCK #
R 58	RMF 174 .5W 1	12126	M1/2T1	620055
R 59	POT 100 1.5W	11236	PRINT	600062
R 60	RCOMP 3.3K .5W 10	01121	RC20	610230
R 61	RCOMP 820.5W10	01121	RC20	610170
R 62	RMF 4.87K .5W 1	12126	M1/2T1	620545
R 63	RCOMP 2.7K .5W 10	*	RC20	610226
R 64	RCOMP 56K .5W 10	*	RC20	610344
R 65	RLTC .7R 5W 3	07088	KM500	630025
R 66	RCOMP 27K .5W 10%	01121	RC20	610320
R 67	RCOMP 100K .5W 10	01121	RCR20	610350
R 68	RCOMP 330 .5W 10%	01121	RC20	610120
R 69	RCOMP 330 .5W 10%	01121	RC20	610120
R 70	POT 150 2W 10%	11236	PRINT	600063
R 71	RMF 3.01K	12126	M1/2T1	620480
R 72	RCOMP 10K .5W 10	01121	RC20	610290
R 73	POT55 2W 10%	12697	PRINT	600299
R 81	RCOMP 1.2K 1W	*	RC20	610192
R 82	RCOMP 15K 5W 10	01121	RCR20	610300
R 83	RCOMP 15K 5W 10	01121	RCR20	610300
R 84	RCOMP 27K .5W 10%	01121	RC20	610320
R 85	RCOMP 2.2 K 2W 10	*	BWH	610220
R 86	POT 150 2W 10%	11236	PRINT	600063
R 87	RCOMP 56 .5W 10%	*	RC20	610036
R 88	RCOMP 330 .5W 10%	01121	RC20	610120

REFERENCE	COMPONENT	MFR	MFR PART NUMBER	STOCK #
R 89	RCOMP 1K .5W 10	01121	RC 20	610180
R 90	RWW 1.8K 2W 1C	*	RWH	640528
R 91	RCOMP 2.2 K 2W 10	*	RWH	610220
R 92	POT 500R 2W	11236	PRINT	600143
R 93	POT 500R 2W	11236	PRINT	600143
R 94	POT 2K 2W 10%	11236		600223
R 96	RCOMP 1.8K .5W 10	*	RC 20	610198
R 98	RLTC .7R 5W 3	07088	KM500	630025
R 99	RCOMP 2.2 .5W 10	01121	RG 20	610003
R 100	RCOMP 2.2 .5W 10	01121	RG 20	610003
R 101	RCOMP 2.2 .5W 10	01121	RG 20	610003
R 102	RCOMP 2.2 .5W 10	01121	RG 20	610003
R 103	RCOMP 2.2 .5W 10	01121	RG 20	610003
R 104	RCOMP 2.2 .5W 10	01121	RG 20	610003
R 105	RCOMP 2.2 .5W 10	01121	RG 20	610003
R 106	RCOMP 2.2 .5W 10	01121	RG 20	610003
S 1	SWITCH ROTARY	11236	PRINT #104330	880650
S 1	SWITCH ROTARY	11236	PRINT #104330	880651
S 102	SWITCH	14604	DRWG6389-6	880007
T 101	TRANSFORMER	09206	PRINT	505321

* ANY GOOD COMMERCIAL GRADE ELECTRICAL EQUIVALENT WHICH IS READILY AVAILABLE MAY BE USED.

REFERENCE	COMPONENT	MFR	MFR PART NUMBER	STOCK #
C 25	CAP.05MF 200V	33498	LTGP50 3M	80 01 68
CR 27	DIODE 2N4441	*	2N4441	72 51 38
Q 18	TRANSISTOR	30045	2N3566	70 01 82
Q 19	TRANSISTOR	07263	2N3638A	70 00 02
R 74	POT 5K .5W	*	ET34P	60 02 87
R 75	RMF 604.5W 1	12126	M1/2TI	62 02 10
R 76	RMF 8.45K .5W 1	12126	M1/2T1	62 05 98
R 77	RCOMP 1K .5W 10	01121	RC20	61 01 80
R 78	RCOMP 1K .5W 10	01121	RC20	61 01 80
R 79	RCOMP 22 .5W 10	01121	RC20	61 00 12
R 80	RCOMP 1K .5W 10	01121	RC20	61 01 80
R 95	RCOMP 1K .5W 10	01121	RC20	61 01 80

* ANY GOOD COMMERCIAL GRADE ELECTRICAL EQUIVALENT WHICH IS READILY AVAILABLE MAY BE USED.



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS, 1/2 WATT, 10%.
   ALL CAPACITORS ARE IN MICROFARADS.
2. S1, S2, AND S3, IS ONE SWITCH. (104330)
3. 'E' VERSION 200-240VAC, INPUT 47-420Hz.

2A 250V MDL	770027	504212	TLB-3E 0V
1.4A 125V MDL	770029	505321	TLB-3 0V
F101	D5101	T101	MODEL

LIST OF MATERIALS OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ON FRACTIONS DECIMALS ANGLES

MATERIAL

FINISH

DRAWING STARTED 3/2/70

TRYGON ELECTRONICS
ROOSEVELT NEW YORK

MODEL TLB-3 0V, E

SCHEMATIC

SIZE E | CODE IDENT NO. 09206 | 10473 | REV P

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